

Claims:

1. Paste-like mass that can be used in electrochemical elements, comprising a heterogeneous mixture of
  - (A) a matrix containing or comprising at least one organic polymer, precursors thereof, or prepolymers thereof,
  - (B) an electrochemically activatable inorganic or largely inorganic liquid that does not dissolve said matrix or essentially does not dissolve said matrix,and,
  - (C) if required, a powdery solid that is essentially inert relative to the electrochemically activatable liquid.
2. Paste-like mass in accordance with claim 1, characterized in that said matrix (A) also contains a plasticizer and/or solvent or swelling agent.
3. Paste-like mass in accordance with claim 1 or 2, characterized in that said matrix (A) is or contains a cross-linkable eliquid or soft resin.
4. Paste-like mass in accordance with claim 3, characterized in that said resin is selected from among cross-linkable addition polymers and condensation resins, especially aminoplasts, phenoplasts, epoxy resins, polyesters, polycarbonates, and methyl methacrylate reaction resins.
5. Paste-like mass in accordance with claim 1 or 2, characterized in that said organic polymer of said matrix (A) is selected from among natural polymers and synthetic polymers and mixtures

thereof, especially natural and synthetic polysaccharides, proteins, resins, waxes, and halogenated and non-halogenated rubbers, thermoplasts, and thermoelastomers.

6. Paste-like mass in accordance with any of the preceding claims, characterized in that said matrix (A) contains or comprises at least one organic polymer that is at least partially dissolved or swollen in a solvent or swelling agent and said organic polymer is selected from among synthetic polymers and natural polymers and mixtures thereof.

7. Paste-like mass in accordance with any of the preceding claims, characterized in that a hygroscopic salt is also worked into said matrix material (A).

8. Paste-like material in accordance with any of the preceding claims, characterized in that said electrochemically activatable liquid (B) is selected from among substances that are suitable for positive electrode material or from among substances that are suitable as negative electrode material or from among substances that are suitable for electrolytes or from among substances that are suitable as ionic or electronic intermediate conductors between two such substances or materials that can be arranged adjacent in an electrochemical element.

9. Paste-like mass in accordance with claim 8, wherein said liquid (B) is an aqueous or anhydrous, inorganic or largely inorganic liquid and contains undissolved solid electrolytes and/or a mixed conductor and/or electrolyte material.

10. Paste-like mass in accordance with claim 8 or 9, wherein said inorganic liquid contains magnesium chloride.

11. Paste-like mass in accordance with claim 8, wherein said liquid is or largely contains vanadium oxihalogenide, aqueous or anhydrous sulfuric acid, potassium hydroxide, or  $\text{LiAlCl}_4/\text{SO}_2$ .

12. Paste-like mass in accordance with any of claims 8 through 11, wherein said inorganic liquid also contains a hydrophilic organic additive, preferably an alcohol.

13. Paste-like mass in accordance with any of the preceding claims, characterized in that said solid substance (C) is selected from among  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{AlN}$ ,  $\text{MgO}$ , or mixtures thereof.

14. Self-supporting layer or layer that can be applied to a substrate, comprising a heterogeneous mixture of

- (A) a matrix containing or comprising at least one organic polymer as defined in any of the preceding claims 1 through 7,
  - (B) an electrochemically activatable inorganic or largely inorganic liquid that does not dissolve said matrix or essentially does not dissolve said matrix,
- and,
- (C) if required, a powdery solid that is essentially inert relative to the electrochemically activatable liquid.

15. Self-supporting layer or layer that can be applied to a substrate in accordance with claim 14, characterized in that said layer is a flexible layer.

16. Composite layer with electrochemical properties, comprising

- (1) a flexible layer containing an organic polymer, said layer containing a material suitable for positive electrodes,

- (2) a layer in accordance with claim 14 or 15, wherein the electrochemically activatable liquid (B) is selected from among substances with electrolyte properties,  
and,

- (3) a flexible layer containing an organic polymer, said layer containing a material suitable for negative electrodes.

17. Composite layer with electrochemical properties, comprising

- (1) a layer in accordance with claim 14 or 15, wherein the inorganic liquid is a liquid material suitable for a cathode or for an anode,  
(2) a flexible layer that contains a solid electrolyte embedded in an organic polymer matrix,

and,

- (3) a flexible layer that contains liquid or solid electrode material embedded in an organic polymer matrix, which electrode material can be the counter-electrode of said electrode material of said layer (1).

18. Composite layer with electrochemical properties in accordance with claim 16 or 17, characterized in that also applied to said layer with positive electrode material is a layer acting as lower contact electrode and to said layer with negative electrode material is a layer acting as upper contact electrode.

19. Composite layer with electrochemical properties in accordance with claim 18, characterized in that also present between said layer acting as lower contact electrode and said layer with positive electrode material and/or between said layer acting as upper contact

electrode and said layer with negative electrode material is a thin plastic layer that contains conductive metallic elements or alloys of these elements that are suitable for transporting electrons from said electrode material to said contact electrode.

20. Composite layer in accordance with any of claims 17 through 19, characterized in that said cathode material is a salt, preferably a lithium salt, dissolved in a proton-separating solvent, preferably  $H_2O$ , and said anode material is an aprotic material.

21. Use of said composite layer in accordance with any of claims 16 through 20 in a primary battery, secondary battery, or decomposition battery.

22. Use of a composite layer in accordance with claim 21, characterized in that said layers have a thickness of approximately 10  $\mu m$  to approximately 2 mm.

23. Use of at least one layer in accordance with any of claims 14 or 15 in a low-temperature fuel cell, in solar cells, or in electrochemical sensors, in particular in an electrochemical sensor for measuring moisture.

24. Method for producing a paste-like mass in accordance with any of claims 1 through 13, characterized in that a cross-linkable pre-polymerisate is combined and mixed thoroughly with said electrochemically activatable liquid (B) and with said solid (C), if any.

25. Method for producing a paste-like mass in accordance with any of claims 1 through 13, characterized in that said organic polymer, precursors thereof, or prepolymers thereof are combined and

thoroughly mixed with a plasticizer and said solid (C), if any, whereupon a solvent is added in which solvent mainly said plasticizer dissolves, said plasticizer dissolved in said solvent is then washed out of said mass and any solvent is removed from said mass, and finally said electrochemically activatable liquid (B) is added.

26. Method for producing a self-supporting layer or layer that is placed upon something in accordance with claim 14 or 15, characterized in that used for said paste-like mass is a mass whose matrix (A) comprises a cross-linkable polymer or prepolymer and said layer produced from said paste-like mass is then subjected to cross-linking of said polymer components, which cross-linking is effected by electron radiation or by heating or by immersing said layer in a chemical cross-linking agent.

27. Method for producing a self-supporting layer or layer that is placed upon something in accordance with claim 26, wherein said matrix (A) comprises a resin and said formed layer is cured using UV or electron radiation.

28. Method for producing a self-supporting layer or layer that is placed upon something in accordance with claim 14 or 15, characterized in that a paste-like mass is produced that comprises a heterogeneous mixture of (A) at least one organic polymer, precursors thereof, or prepolymers thereof, a plasticizer, and a solvent or swelling agent, and (C) a powdery solid, if required, or that contains these components, said paste-like mass then being converted into the desired layer form and said form being solidified by evaporating the

solvent or swelling agent and any additional measures, in that then a solvent for the plasticizer is used for extracting the latter from the solidified layer, and finally the cavities that result therefrom are filled by immersing in (B) with an electrochemically activatable inorganic or largely inorganic liquid that does not dissolve said matrix or essentially does not dissolve said matrix.

29. Method in accordance with claim 28, characterized in that said inorganic or largely inorganic liquid is a salt dissolved in a solvent that is at least partially organic, and in that once said cavities have been filled, the organic components of said solvent are extracted and replaced with an inorganic component, preferably H<sub>2</sub>O.

30. Method for producing a composite layer in accordance with any of claims 17 through 20, characterized in that each paste-like mass provided for a layer is successively applied to a substrate using a paste application method, particularly preferably using a pressure method, and said layers are then brought into their final solidified state.

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## PASTE-LIKE MASS WITH INORGANIC, LIQUID CONDUCTORS AND LAYERS AND ELECTROCHEMICAL ELEMENTS PRODUCED THEREFROM

The present invention relates to paste-like masses that can be used in electrochemical elements, comprising a heterogeneous mixture of (A) a matrix containing or comprising at least one organic polymer, precursors thereof, or prepolymers thereof, (B) an electrochemically activatable inorganic or largely inorganic liquid that does not dissolve the matrix or essentially does not dissolve the matrix, and, if required, (C) a powdery solid that is essentially inert relative to the electrochemically activatable liquid. The invention furthermore relates to self-supporting layers or layers that are placed on a substrate, comprising a heterogeneous mixture of (A) a matrix containing or comprising at least one organic polymer as defined in any of claims 1 through 7, (B) an electrochemically activatable inorganic or largely inorganic liquid that does not dissolve the matrix or essentially does not dissolve matrix, and if required, (C) a powdery solid that is essentially inert relative to the electrochemically activatable liquid, and composite layers with electrochemical properties that contain such layers. The layers and composite layers can be used advantageously for producing batteries, low-temperature fuel cells, solar cells, or electrochemical sensors.